

What is claimed is:

- 1 1. An ESD protection circuit with high substrate-
2 triggering efficiency comprising:
3 a multi-finger-type device having a plurality of finger
4 gates below which parasitic BJTs are formed, a
5 plurality of finger sources, each of which is an
6 emitter of one of the parasitic BJTs, and at
7 least one finger drain coupled to a pad;
8 a plurality of voltage drop elements, each of which is
9 coupled between one of the finger sources and a
10 power line to detect a transient current flowing
11 through one of the finger gates; and
12 a plurality of feedback circuits, each of which is
13 coupled between a base and an emitter
14 respectively of a first and second parasitic BJT,
15 and activates the first BJT to bypass ESD current
16 during an ESD event.
- 1 2. The ESD protection circuit as claimed in claim 1,
2 wherein the multi-finger-type device is a multi-finger-type
3 NMOS.
- 1 3. The ESD protection circuit as claimed in claim 1,
2 wherein the multi-finger-type device is a multi-finger-type
3 PMOS.
- 1 4. The ESD protection circuit as claimed in claim 1,
2 wherein one of the finger gates is coupled to the power
3 line.

1 5. The ESD protection circuit as claimed in claim 4,
2 wherein one of the finger gates is coupled to the power line
3 through a resistor.

1 6. The ESD protection circuit as claimed in claim 1,
2 wherein one of the finger gates is coupled to a pre-driver.

1 7. The ESD protection circuit as claimed in claim 1,
2 wherein the voltage drop elements are resistors.

1 8. The ESD protection circuit as claimed in claim 7,
2 wherein the resistors are formed by a well of a first
3 conductivity in a substrate of a second conductivity.

1 9. The ESD protection circuit as claimed in claim 1,
2 wherein the voltage drop elements are inductors.

1 10. The ESD protection circuit as claimed in claim 1,
2 wherein one of the voltage drop elements is a diode.

1 11. The ESD protection circuit as claimed in claim 1,
2 wherein one of the voltage drop elements is a series of
3 diodes.

1 12. The ESD protection circuit as claimed in claim 1,
2 wherein each of the feedback circuits couples the base of
3 the first parasitic BJT to a collector of the second
4 parasitic BJT.

1 13. The ESD protection circuit as claimed in claim 1,
2 wherein each of the feedback circuits couples the base and a

3 collector of the first parasitic BJT, and a collector of the
4 second parasitic BJT together.

1 14. The ESD protection circuit as claimed in claim 1,
2 wherein the multi-finger-type device is a stacked MOS.

1 15. An ESD protection circuit with high substrate-
2 triggering efficiency formed on a substrate of a second
3 conductivity comprising:

4 a guard ring of the second conductivity formed on the
5 substrate as a contact region thereof;

6 a plurality of fingers enclosed by the guard ring, each
7 of which has a finger source formed by a first
8 doping region of a first conductivity, a finger
9 drain formed by a second doping region of the
10 first conductivity and coupled to a pad, a finger
11 gate between the first and second doping region,
12 and a substrate current input node formed by a
13 third doping region of the second conductivity
14 enclosed by the second doping region, wherein the
15 first and second doping region, and the proximate
16 substrate form a parasitic BJT;

17 a plurality of resistors formed by wells, each of which
18 is coupled between one of the finger sources and
19 a power line; and

20 internal connection circuits coupling one of the finger
21 sources to one of the substrate current input
22 nodes to activate a second parasitic BJT by
23 current flowing through a first parasitic BJT and

24 one of the resistors coupled thereto during an
25 ESD event.

1 16. The ESD protection circuit as claimed in claim 15,
2 wherein each of the resistors is formed by a well of the
3 second conductivity between the first doping region and a
4 fourth doping region coupled to the power line.

1 17. The ESD protection circuit as claimed in claim 15,
2 wherein a field oxide is disposed between the first and
3 fourth doping region to increase a resistance of the well.

1 18. The ESD protection circuit as claimed in claim 15,
2 wherein a field oxide is disposed between the second and
3 third doping region isolating one region from the other.

1 19. The ESD protection circuit as claimed in claim 15,
2 wherein a dummy gate is disposed between the second and
3 third doping region isolating one region from the other.